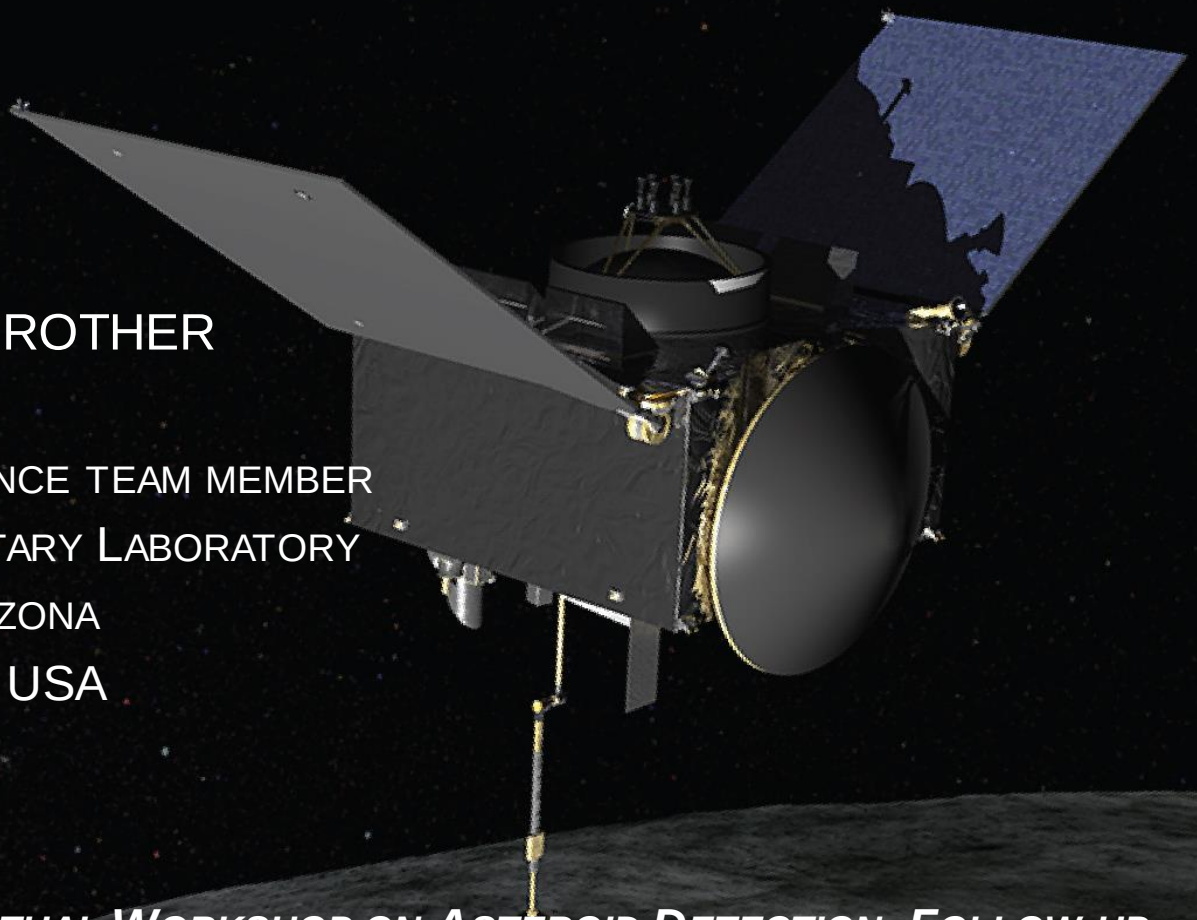
Using small telescopes to obtain phase function photometry



OSIRIS-REx™
Asteroid Sample Return Mission

Carl Hergenrother

OSIRIS-REx Science team member
Lunar and Planetary Laboratory
University of Arizona
Tucson, Arizona, USA

South Africa Virtual Workshop on Asteroid Detection, Follow-up and Characterisation – 2014 March 10-11

Summary of Talk

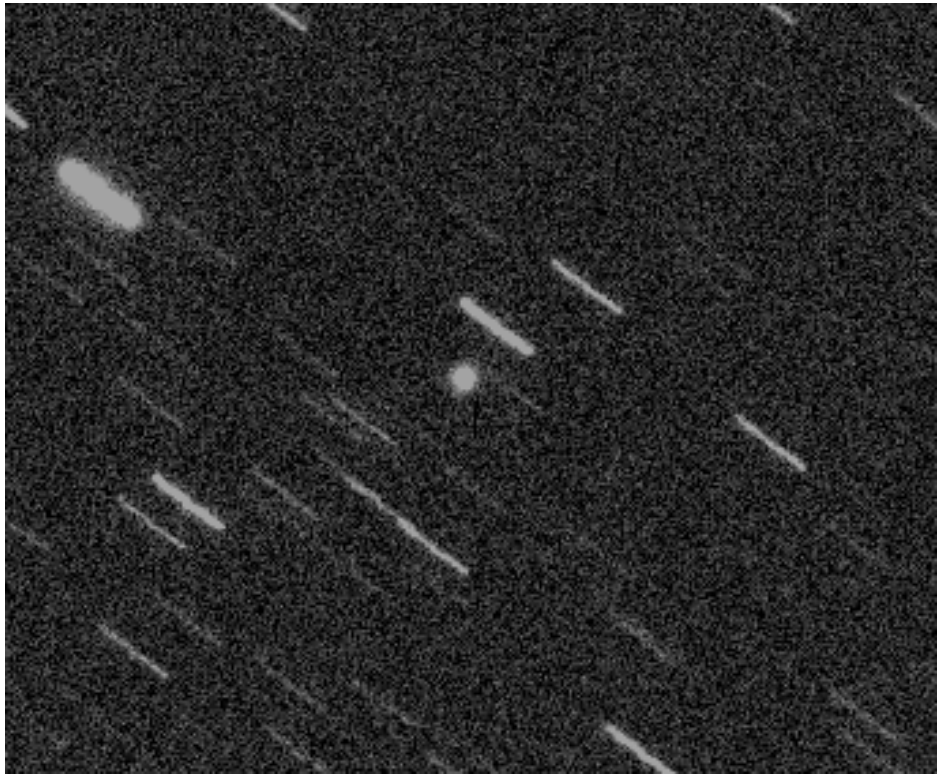
- Phase function photometry
- How small telescope users can help

- How the OSIRIS-REx Target Asteroids! citizen science program uses phase function photometry

- How phase function data helps current and future spacecraft missions

The Goal of all asteroid characterization …

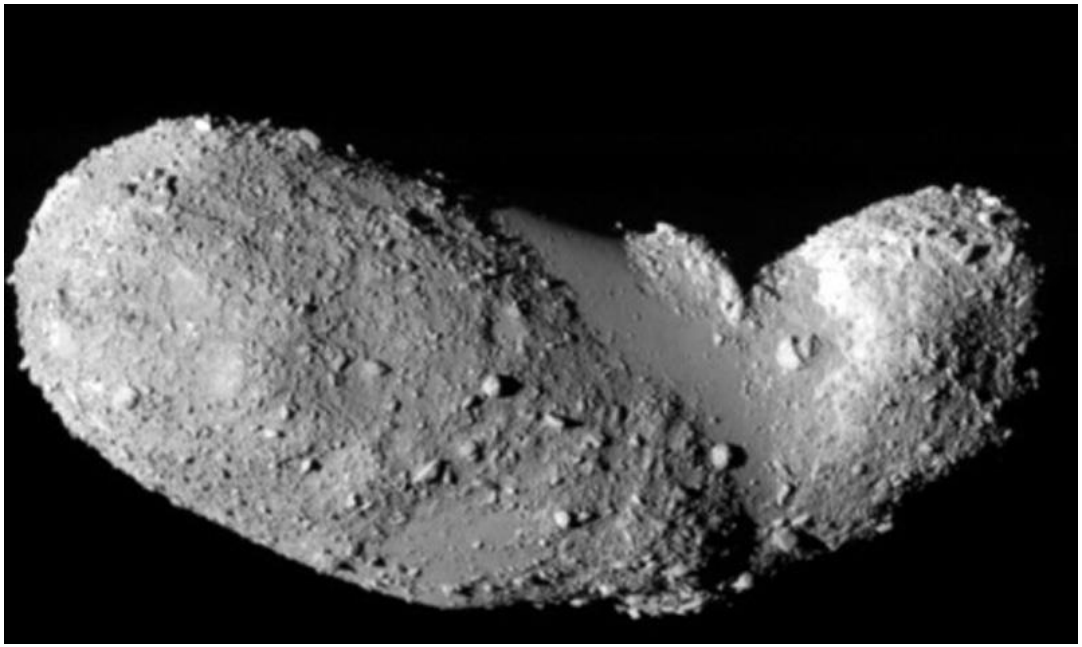
Turning a point of light ...



The Goal of all asteroid characterization …

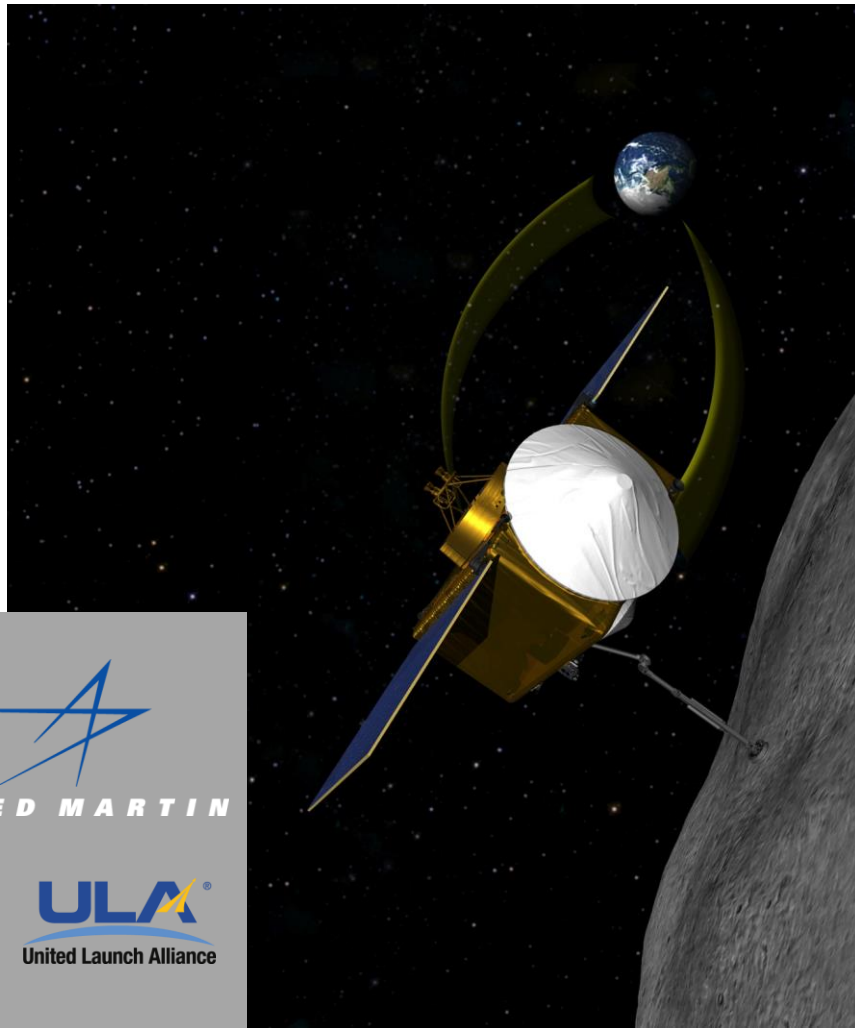
Turning a point of light ...

… into a World!



INTRODUCING OSIRIS-REX

OSIRIS-REx™
ASTEROID SAMPLE RETURN MISSION



THE UNIVERSITY OF ARIZONA
Lunar and Planetary Laboratory

NASA

LOCKHEED MARTIN

ASU ARIZONA STATE UNIVERSITY

CSA ASC

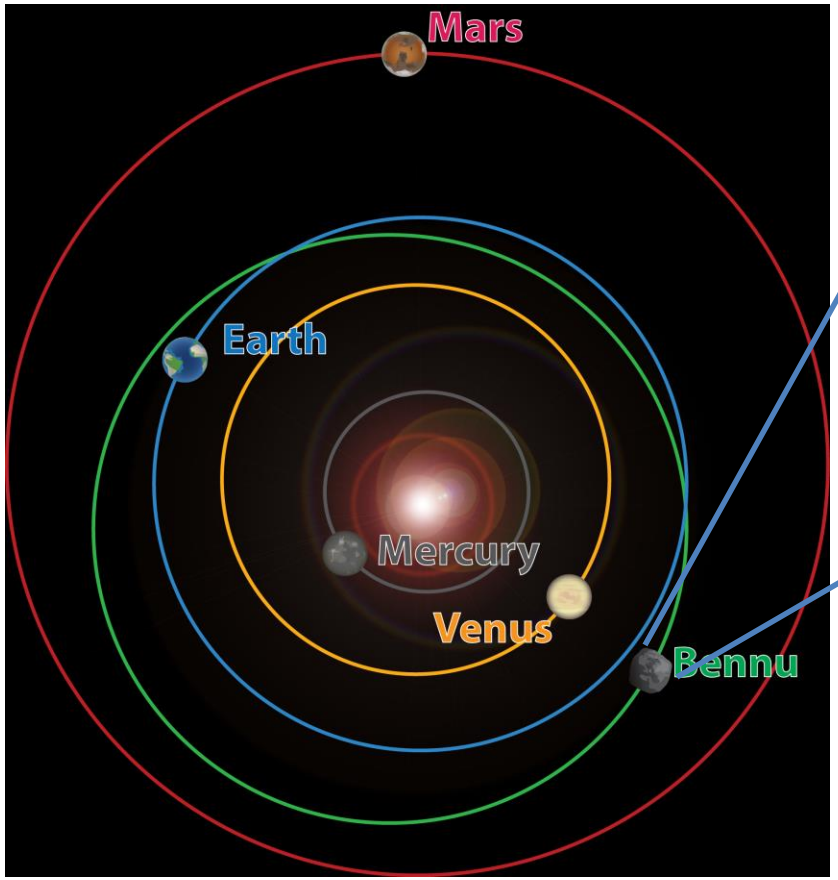
cnes

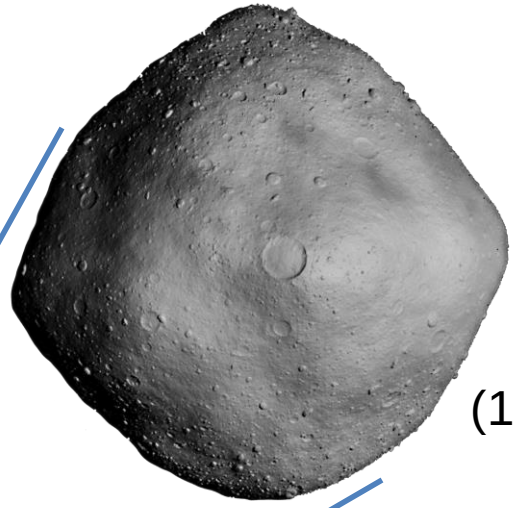
KINETX AEROSPACE

MIT

ULA United Launch Alliance

THE OSIRIS-REX TARGET ASTEROID

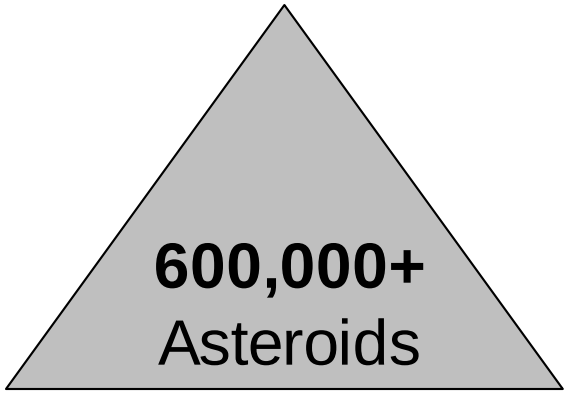


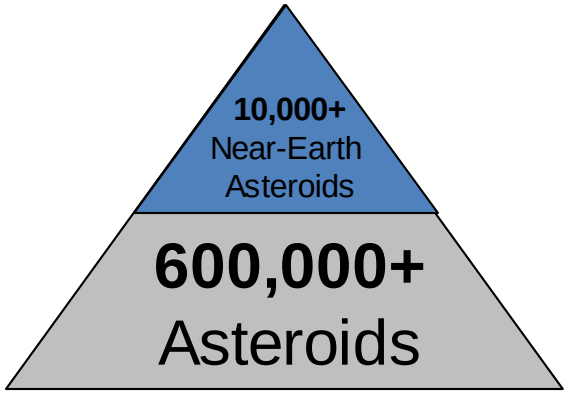


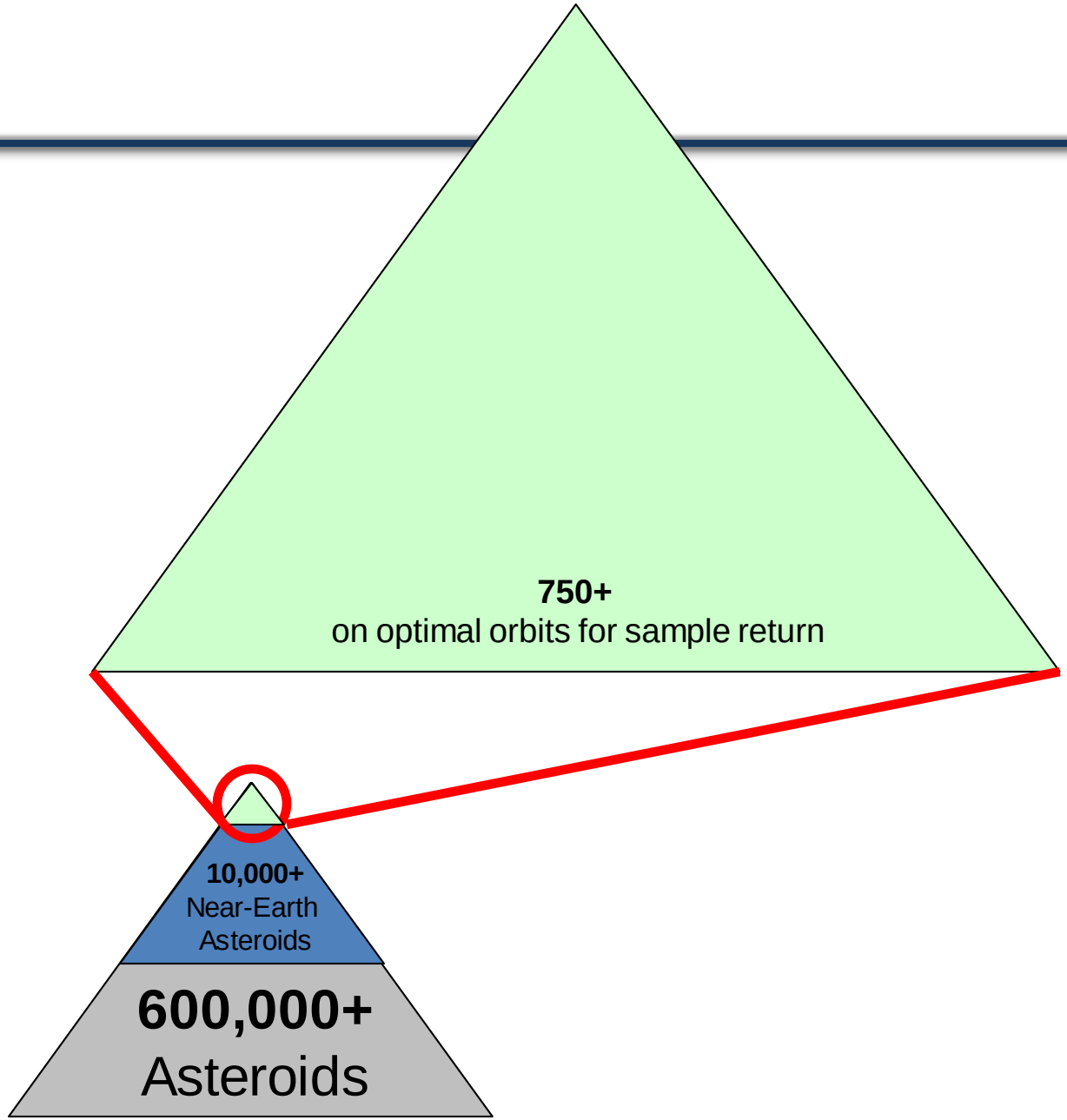
(101955) Bennu

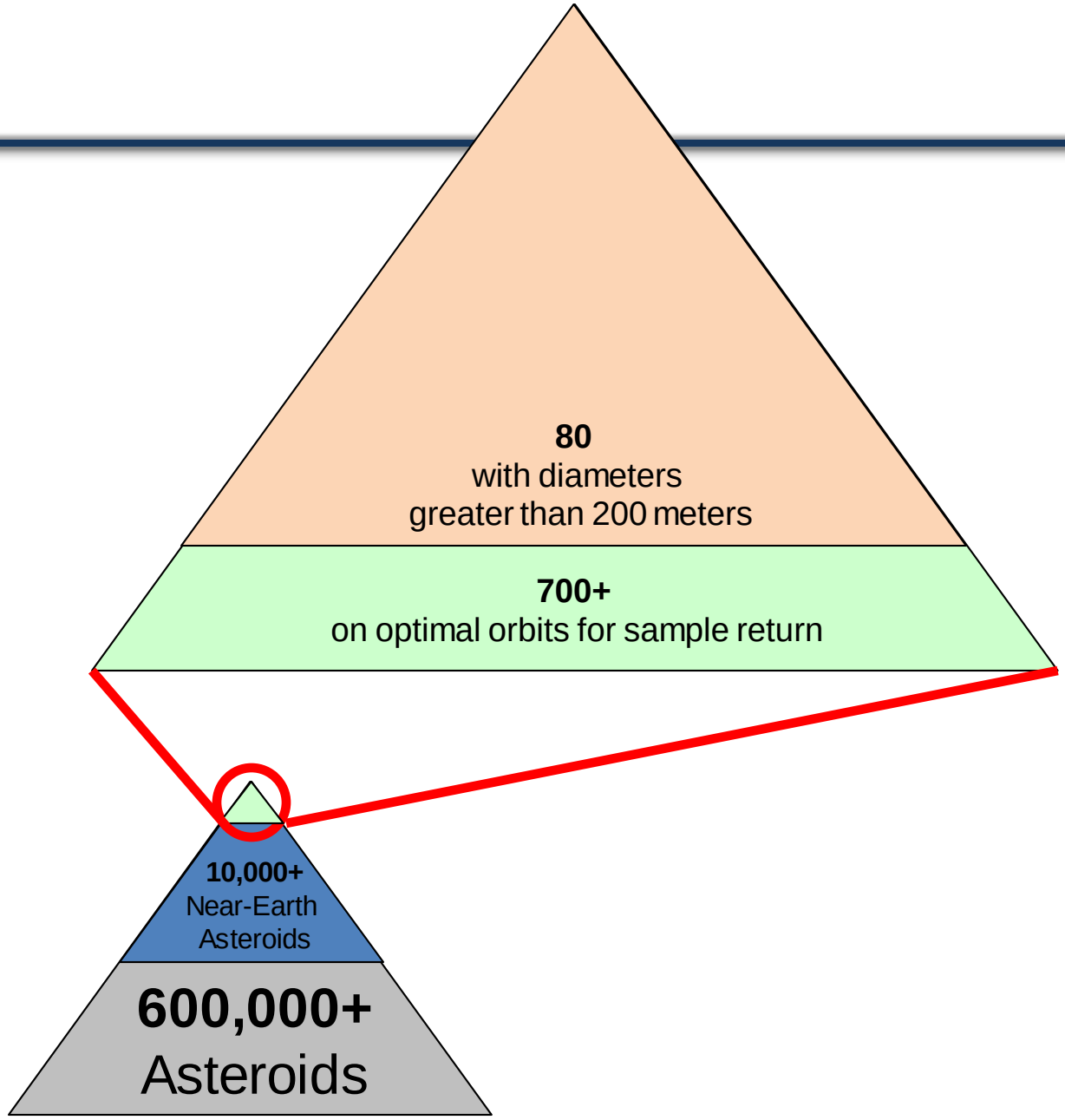
Launch in 2016
Arrive at Bennu in 2018
Acquire Sample of Bennu in 2019
Return Sample to Earth in 2023

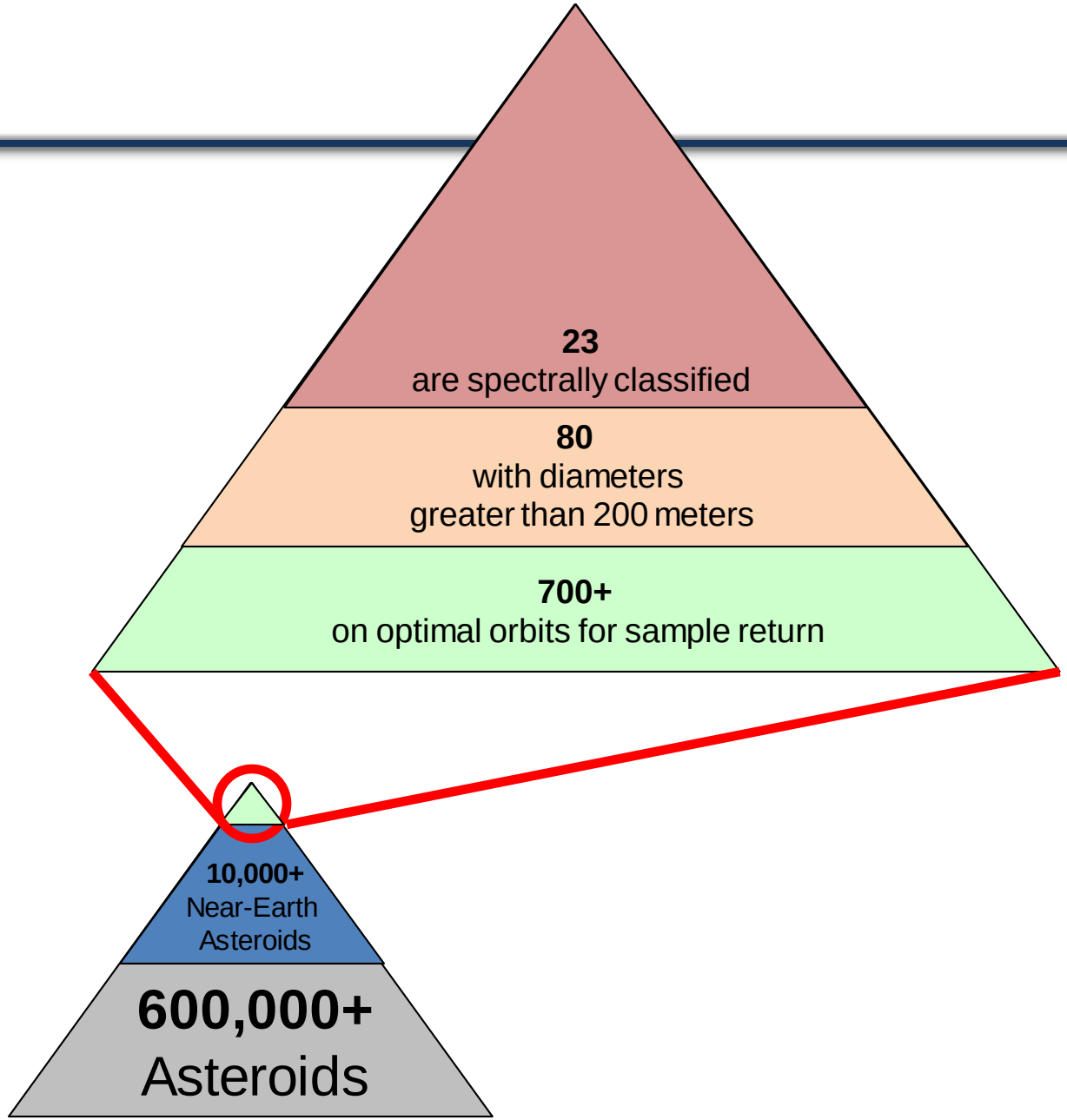
THE LONG ROAD TO BENNU…




10,000+
Near-Earth
Asteroids
600,000+
Asteroids


750+
on optimal orbits for sample return
10,000+
Near-Earth
Asteroids
600,000+
Asteroids


80
with diameters
greater than 200 meters
700+
on optimal orbits for sample return
10,000+
Near-Earth
Asteroids
600,000+
Asteroids


23
are spectrally classified
80
with diameters
greater than 200 meters
700+
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10,000+
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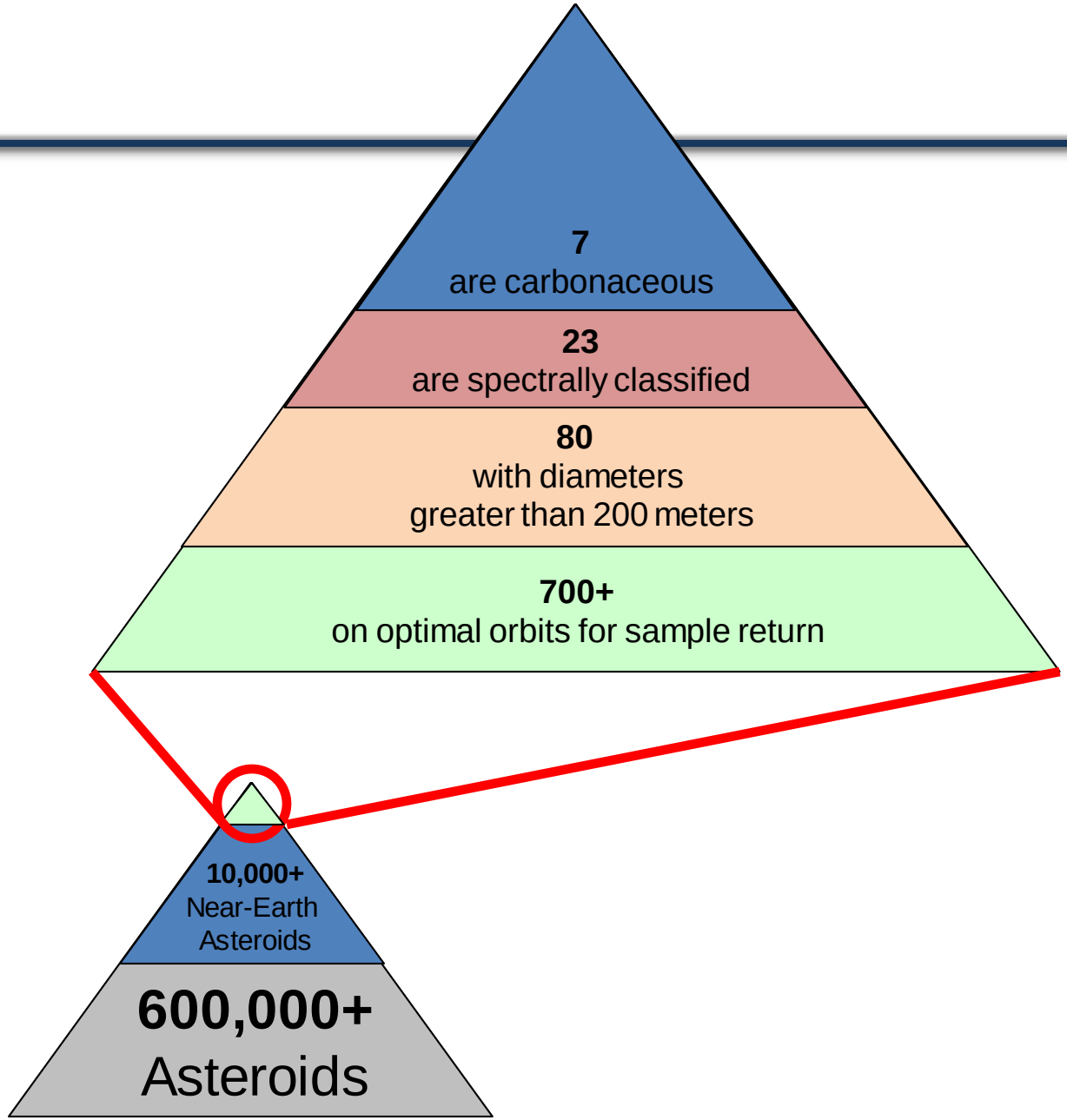
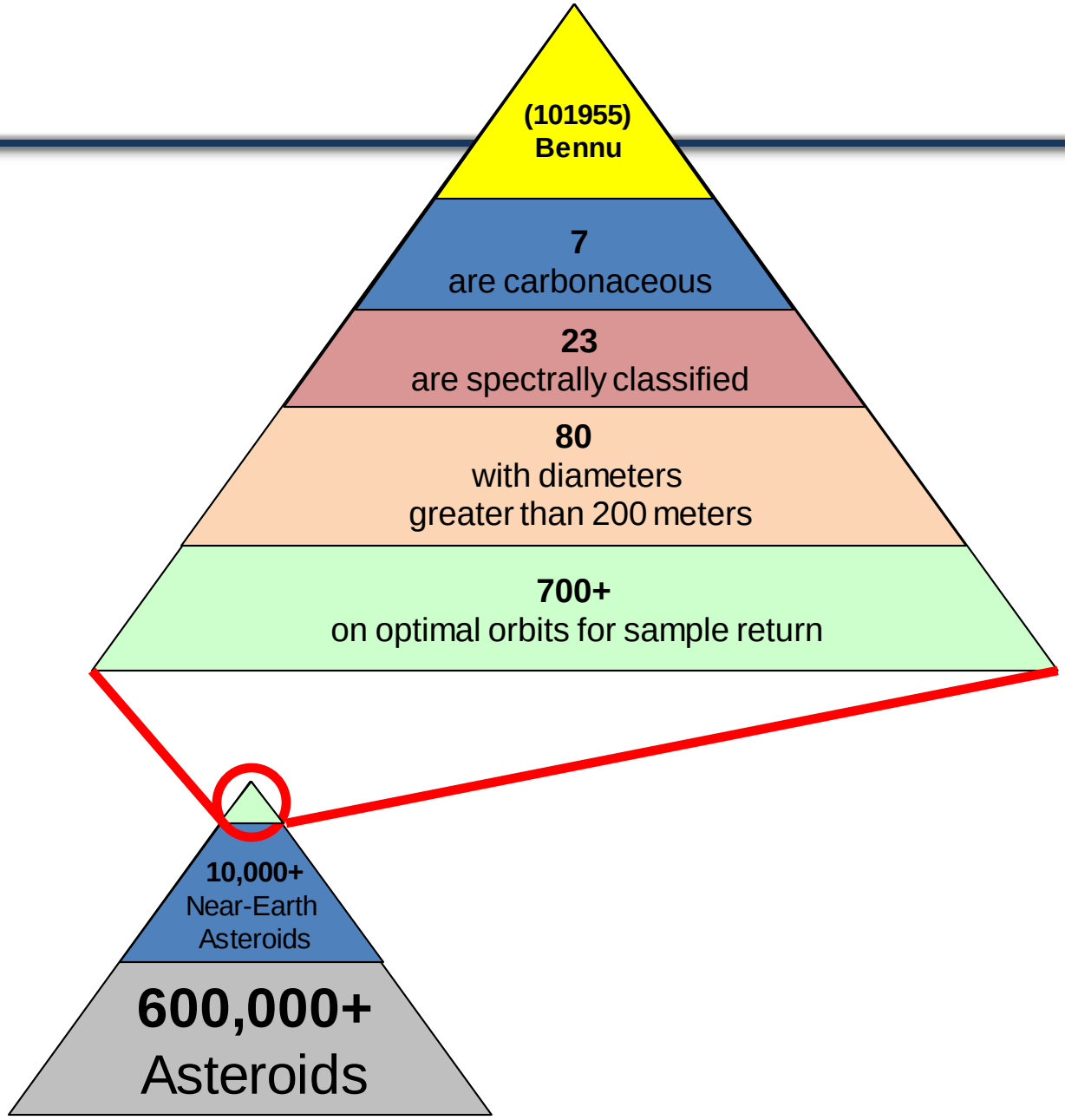

7
are carbonaceous
23
are spectrally classified
80
with diameters
greater than 200 meters
700+
on optimal orbits for sample return
10,000+
Near-Earth
Asteroids
600,000+
Asteroids


(101955)
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How can small telescope users help

- The question was how could the typical backyard observer with a 8” (0.2-m) telescope and commercial CCD camera help characterize ‘faint’ spacecraft target NEAs
- Most are too faint for work that requires high S/N obs

- What could be done with low S/N photometry, especially lots of low S/N photometry

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Enter ==========>

What is Phase Function Photometry

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WHAT IS PHASE FUNCTION PHOTOMETRY

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- Phase angle is the Sun-Object-Observer angle

What is Phase Function Photometry

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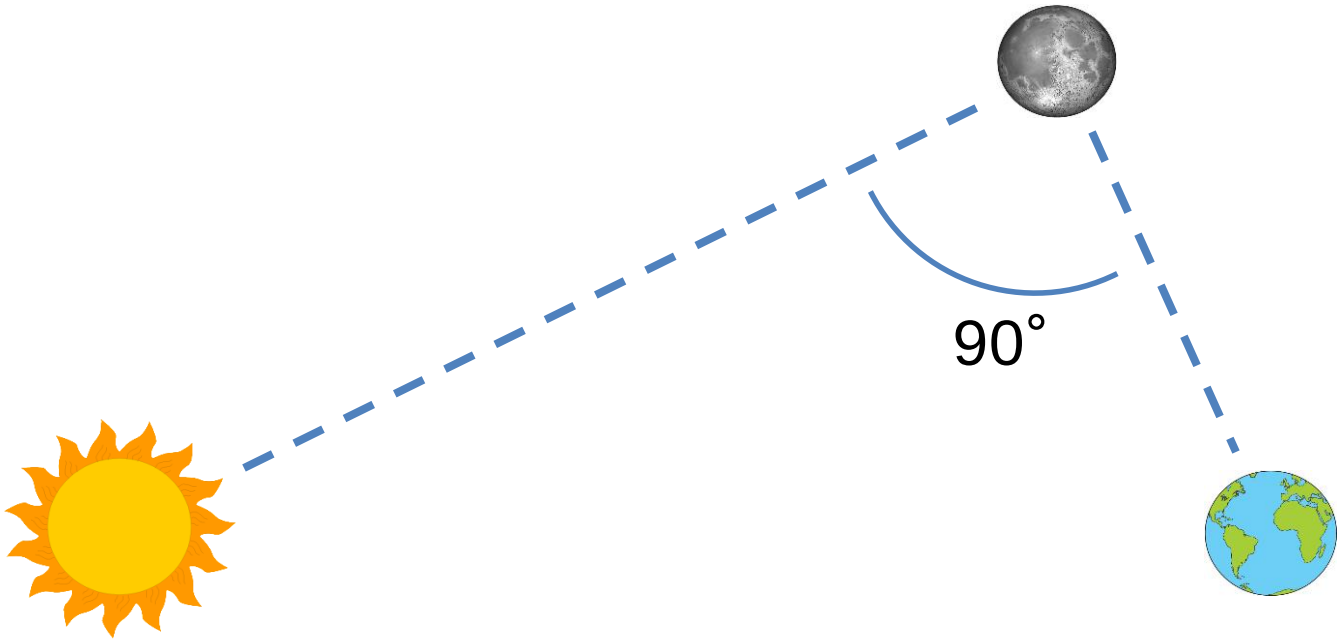
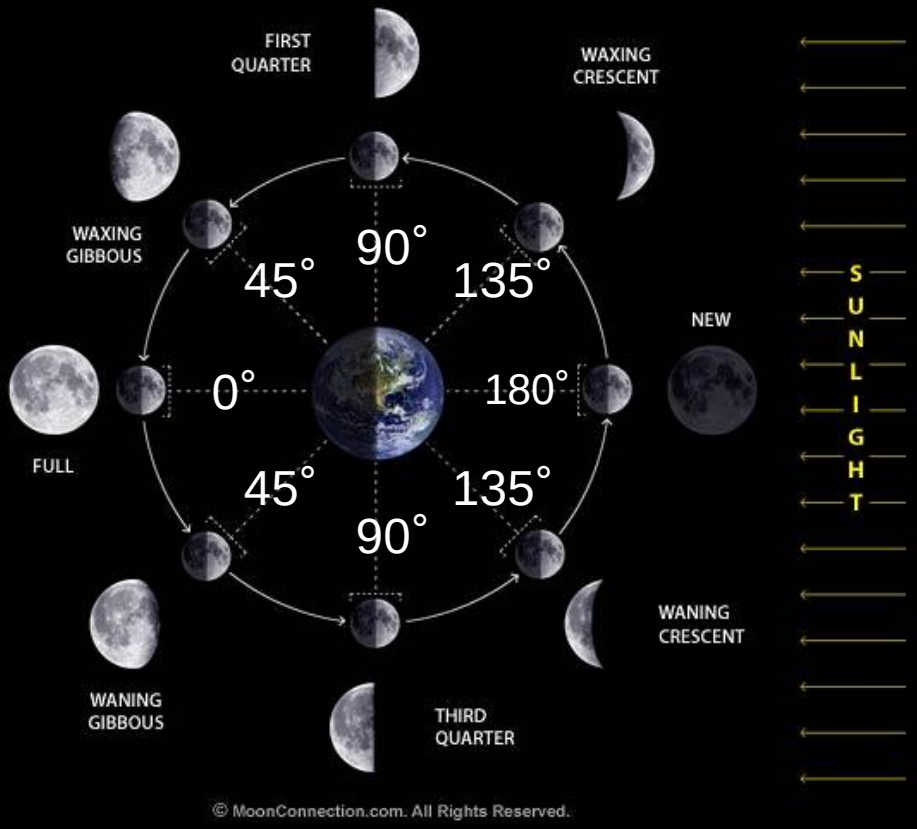
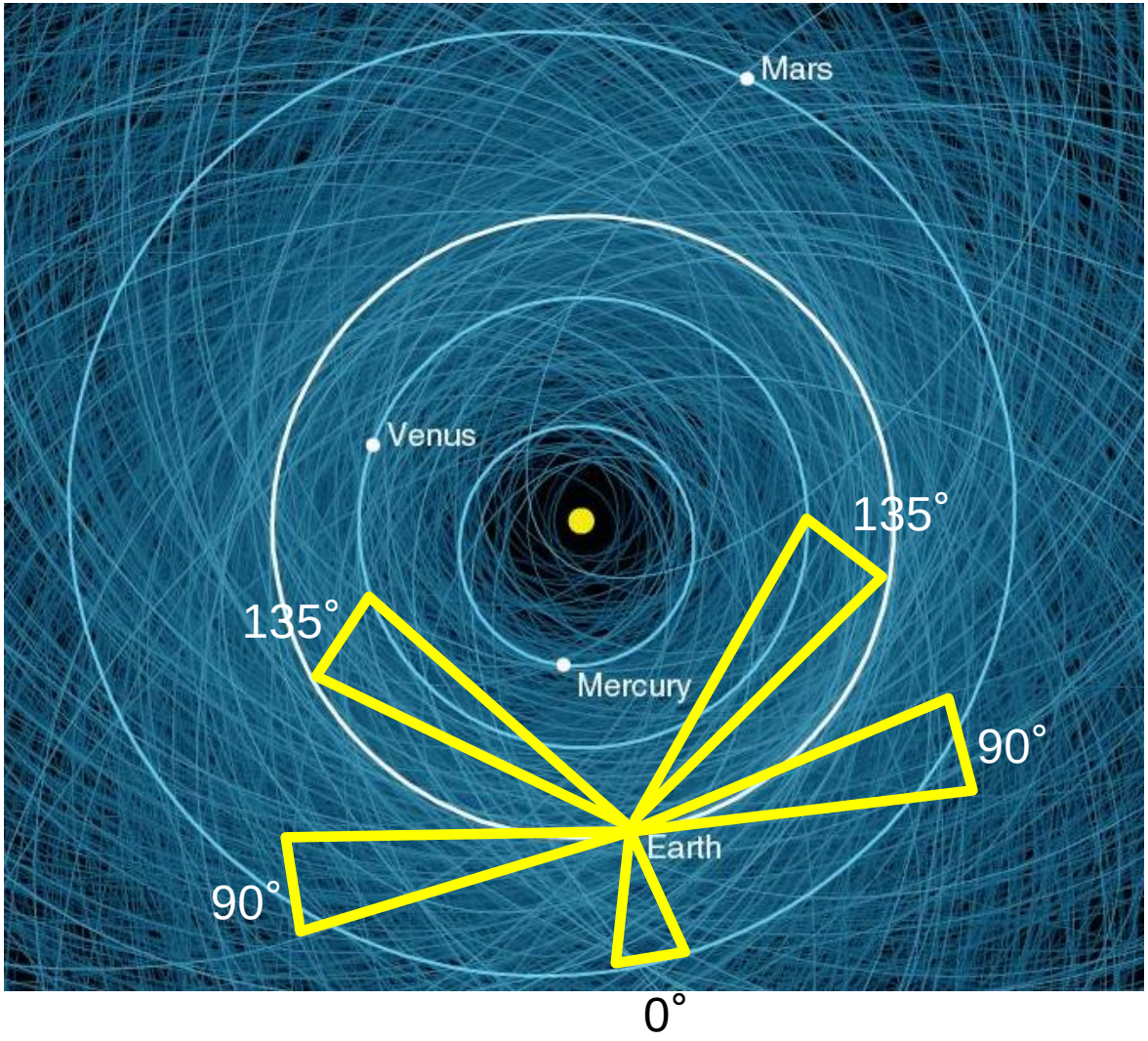


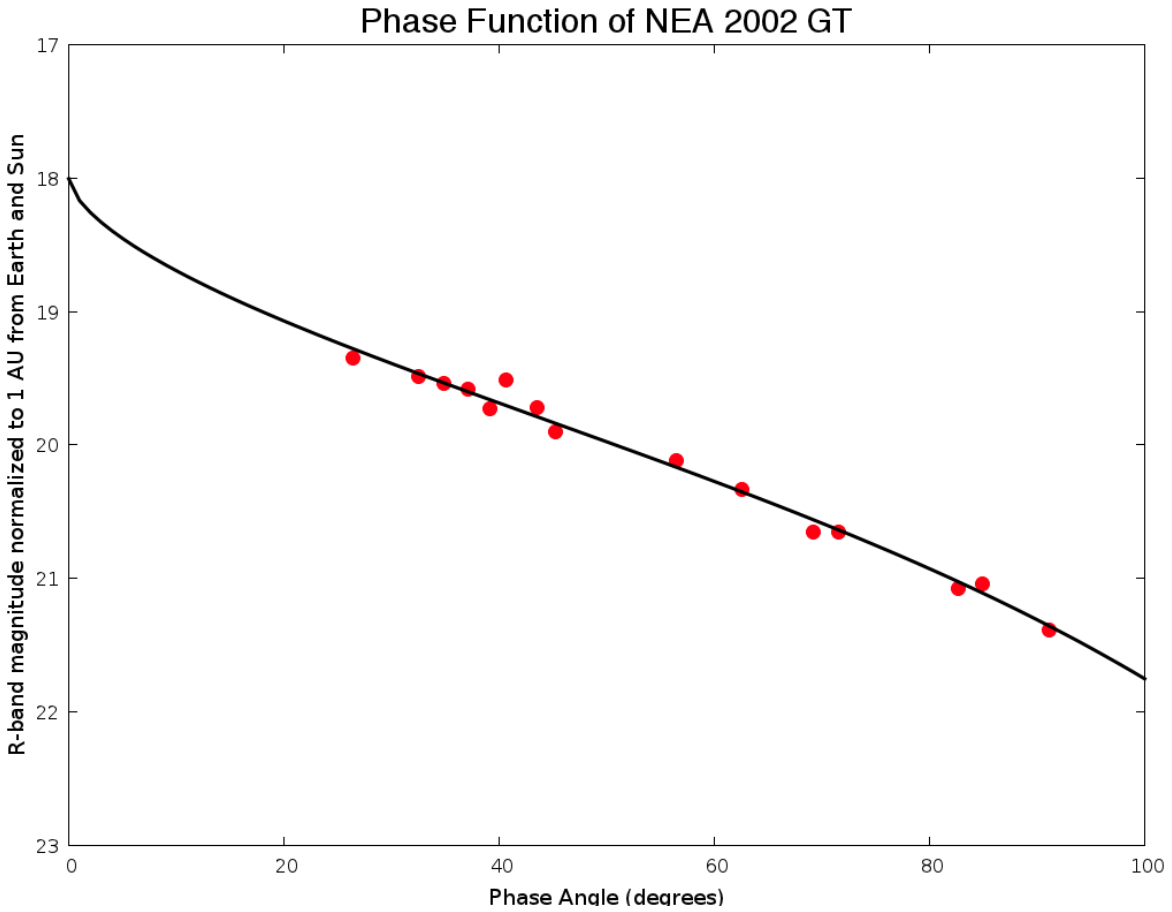
ANOTHER WAY TO LOOK AT PHASE ANGLE



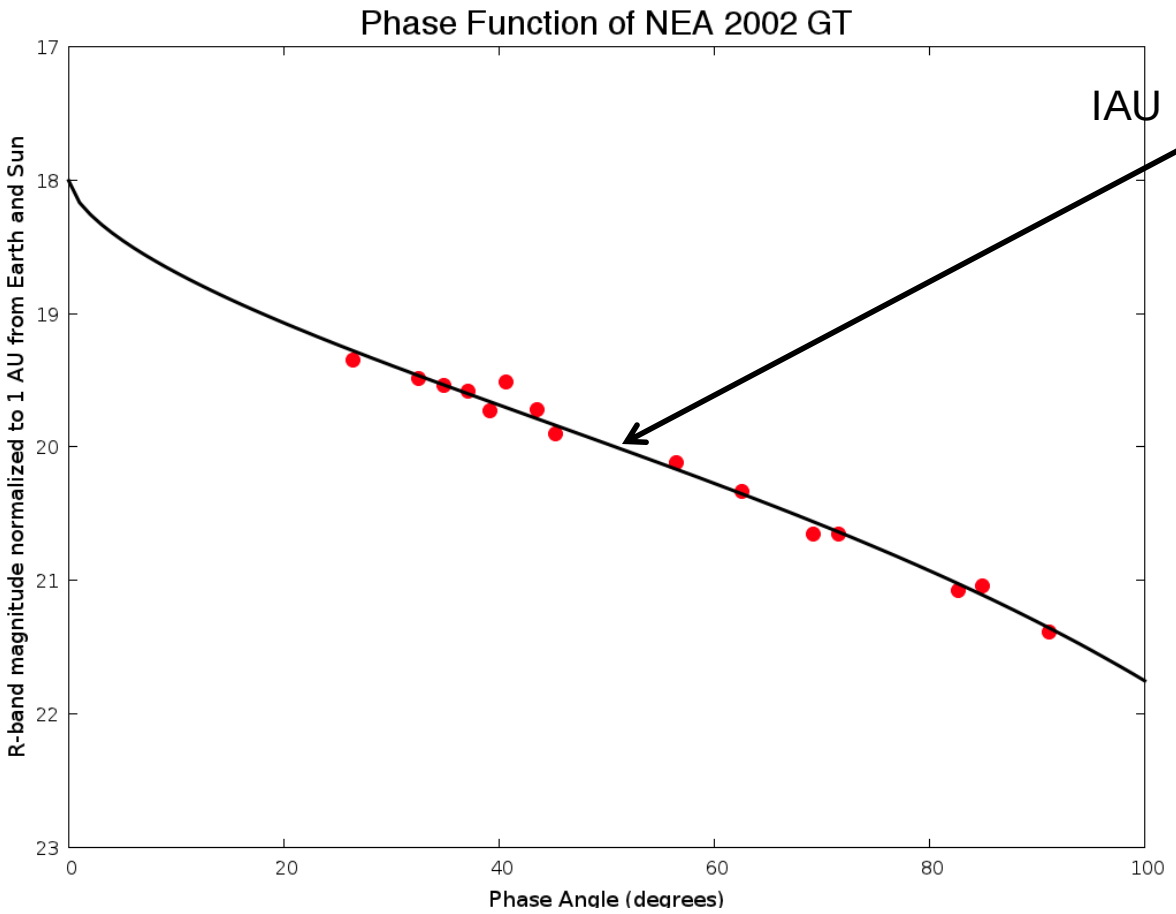
PHASE ANGLES IN THE INNER SOLAR SYSTEM



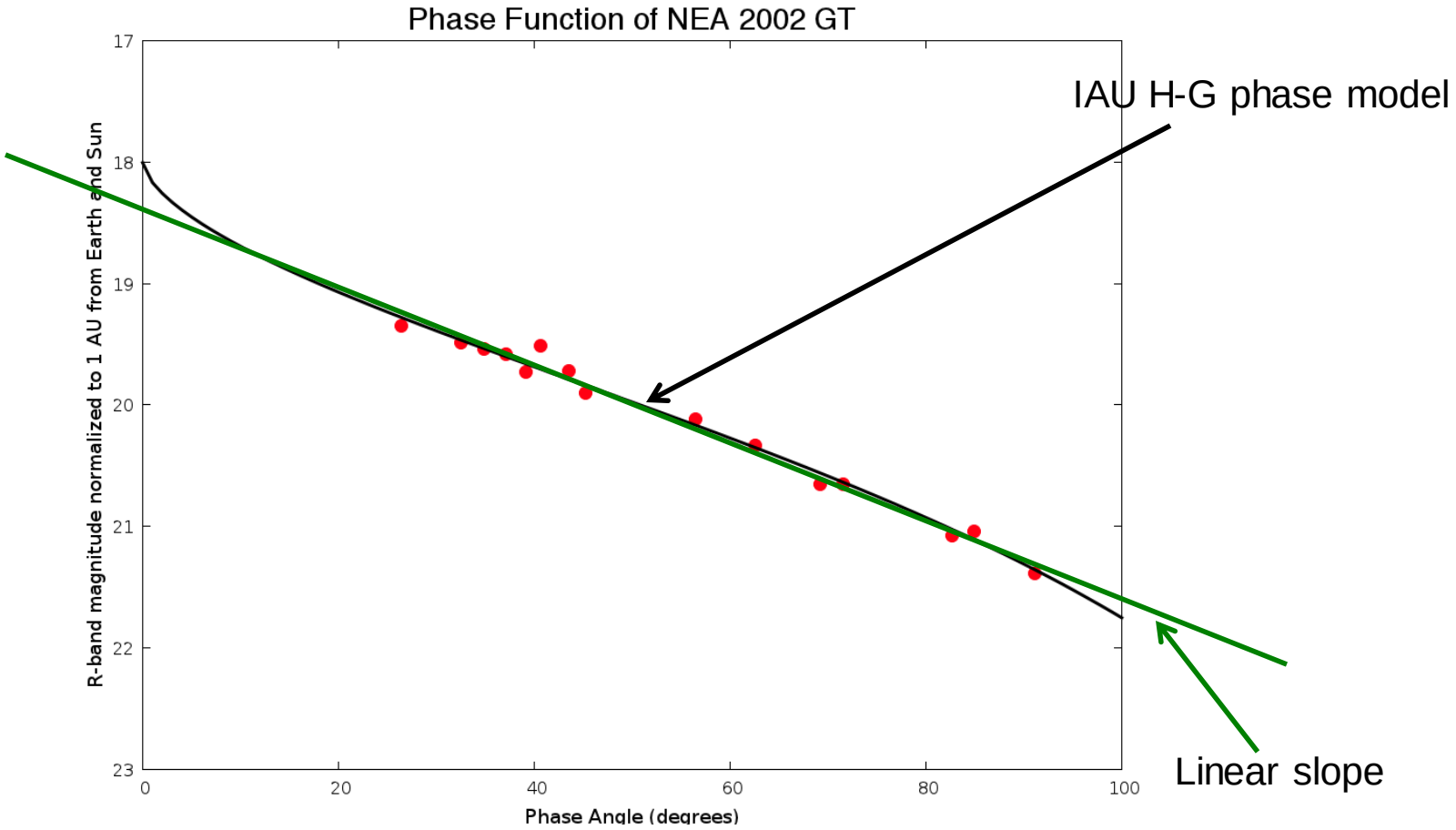
PHASE FUNCTIONS IN ACTION



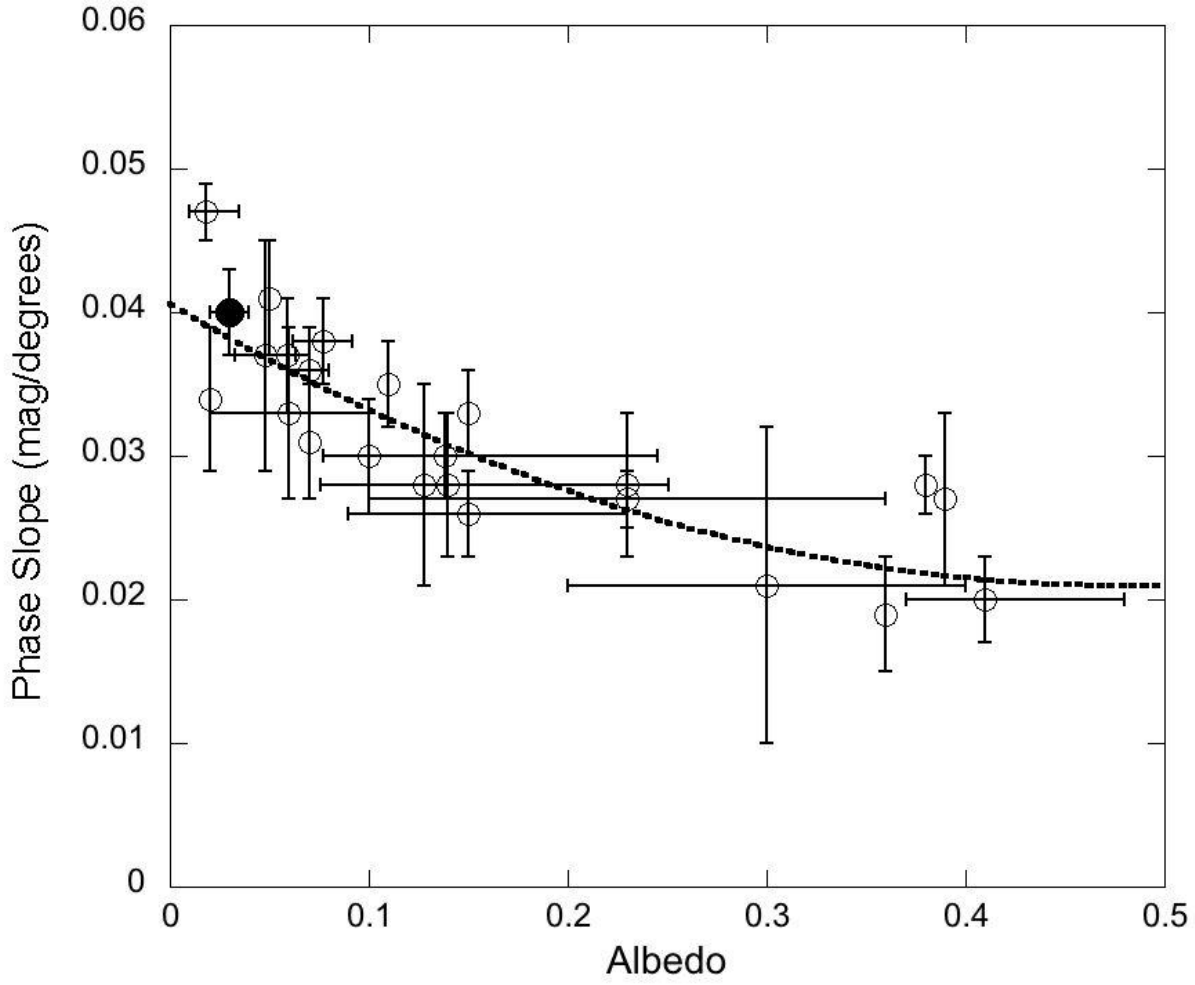
PHASE FUNCTIONS IN ACTION



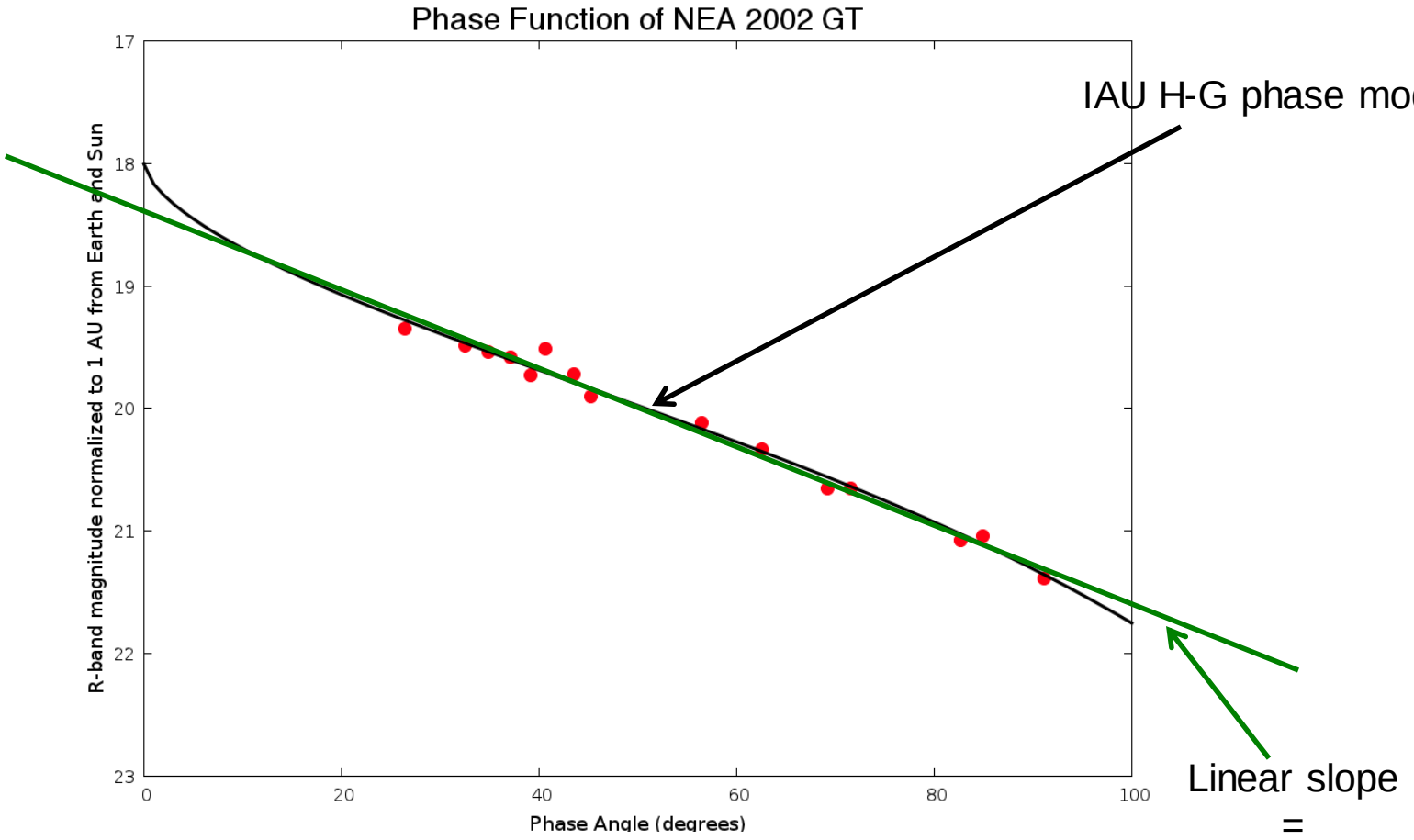
PHASE FUNCTIONS IN ACTION



RELATIONSHIP BETWEEN SLOPE OF PHASE FUNCTION AND ALBEDO

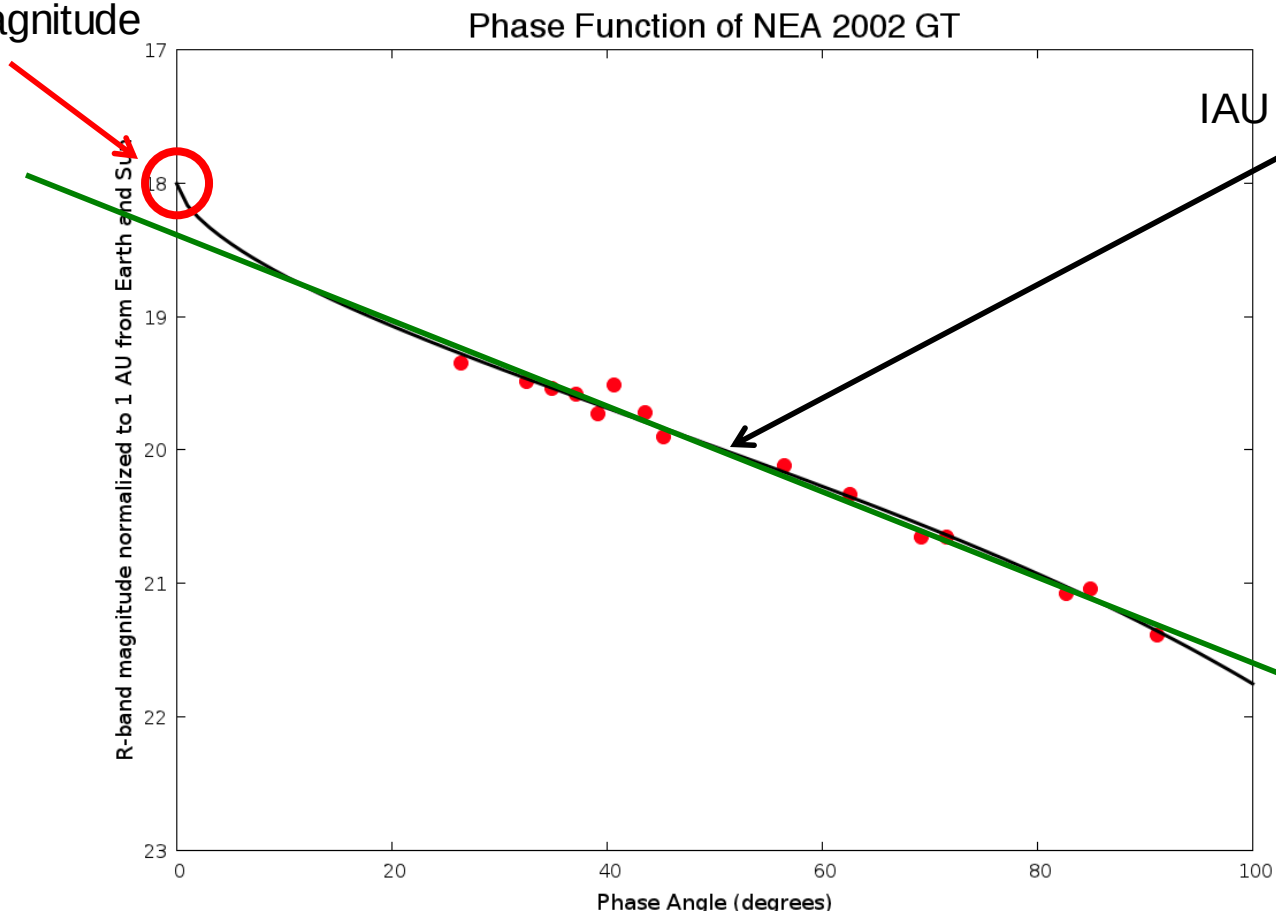


PHASE FUNCTIONS IN ACTION



PHASE FUNCTIONS IN ACTION

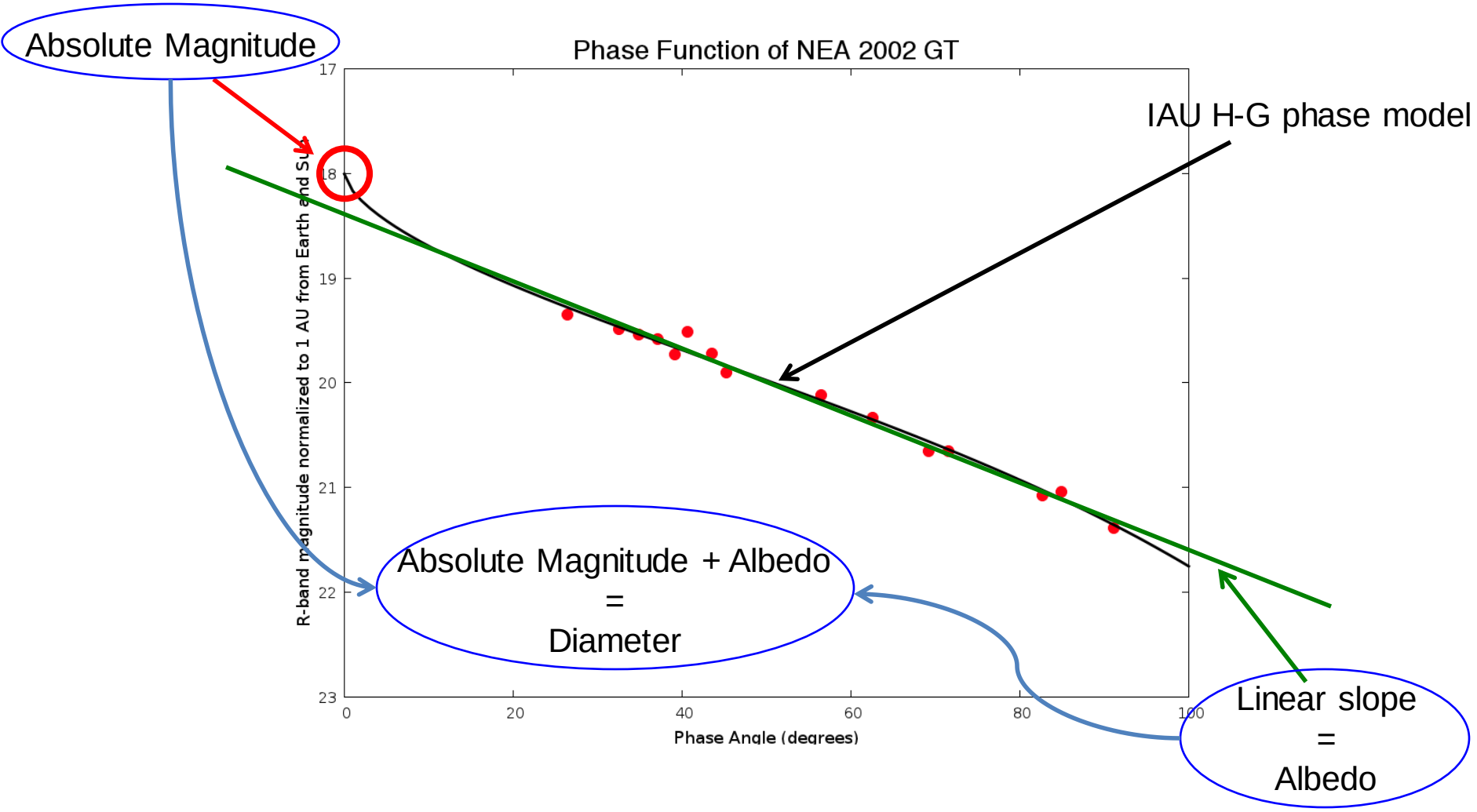
Absolute Magnitude



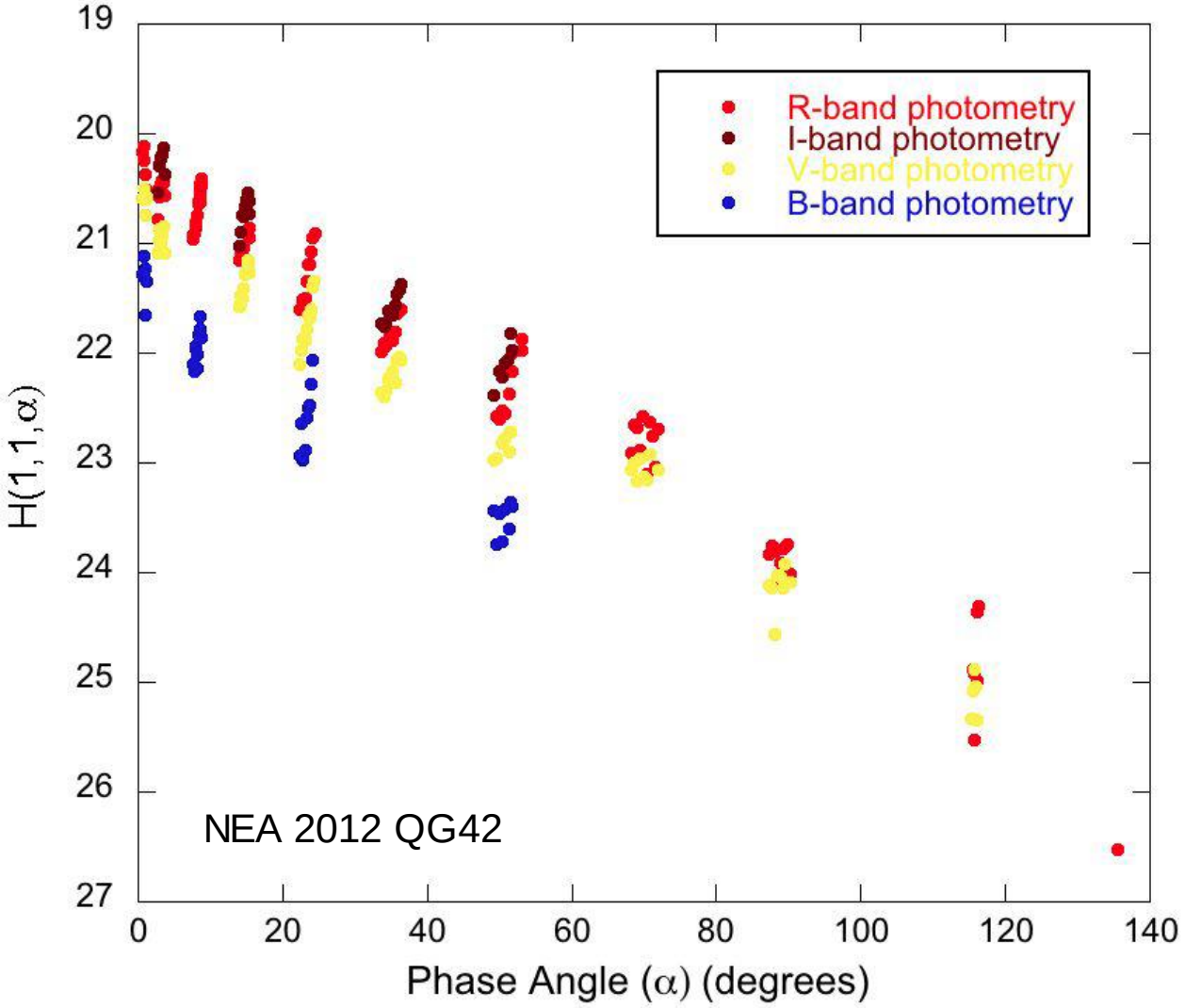
IAU H-G phase model

Linear slope
=
Albedo

PHASE FUNCTIONS IN ACTION



COLOR PHASE FUNCTIONS YIELD TAXONOMY



YOU CAN NEVER HAVE TOO MUCH DATA…

- Bennu, the OSIRIS-REx target asteroid, is one of the best characterized NEAs not yet visited by a spacecraft
- Yet, there are still major gaps in our understanding
- These gaps directly affect mission planning and design
- Only by observing many objects can we fill in the holes in our understanding of any particular object

THIS IS A WORLD-WIDE EFFORT

- *Target Asteroids!* has attracted over 201 participants from 33 countries covering every continent except Antarctica

- But biases are obvious

WE NEED YOU!

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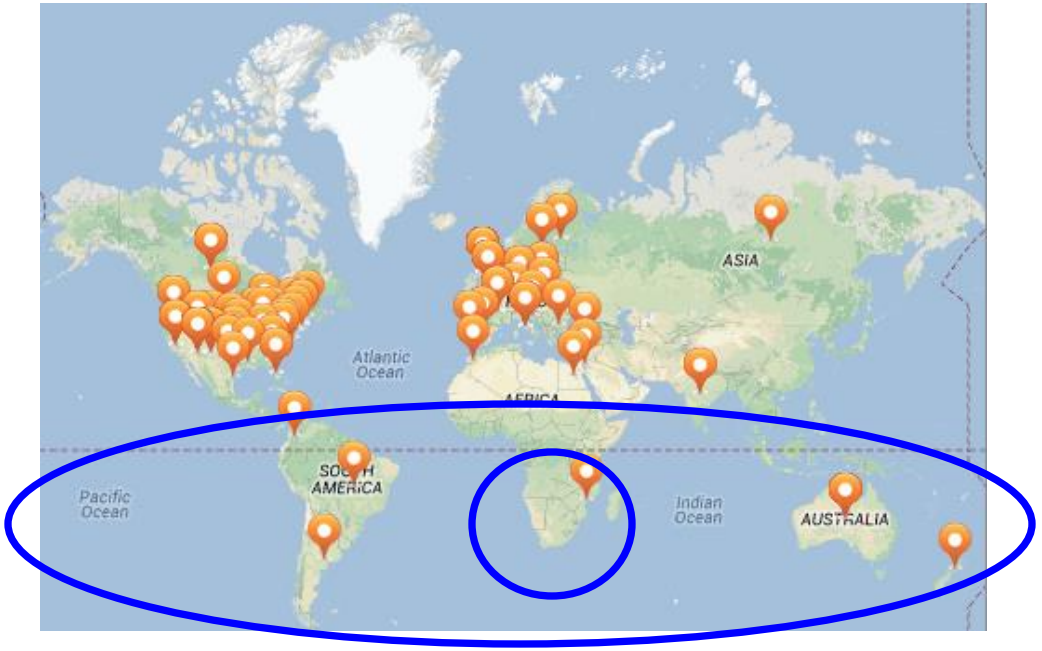

For more information… contact us

Visit the Website

http://osiris-rex.lpl.arizona.edu/?q=target_asteroids

Carl Hergenrother

chergen@lpl.arizona.edu